
QPC450 CO/FX/WATS Trunk Card

Introduction

The QPC450 CO/FX/WATS Trunk Card is a peripheral equipment (PE) device that can be installed in any peripheral shelf or NT8D13 Peripheral Equipment (PE) Module. The CO/FX/WATS trunk card interfaces four analog trunk lines to the Meridian 1 switch. Each trunk is independently configurable using the Trunk Administration program (LD 14).

The CO/FX/WATS trunk card is used in μ -Law trunk applications. It complies with Electronic Industries Association (EIA) transmission standards except for its terminating impedance and balancing network, which are matched against 600 ohm in series with 2.16 μ F and 900 ohm in series with 2.16 μ F.

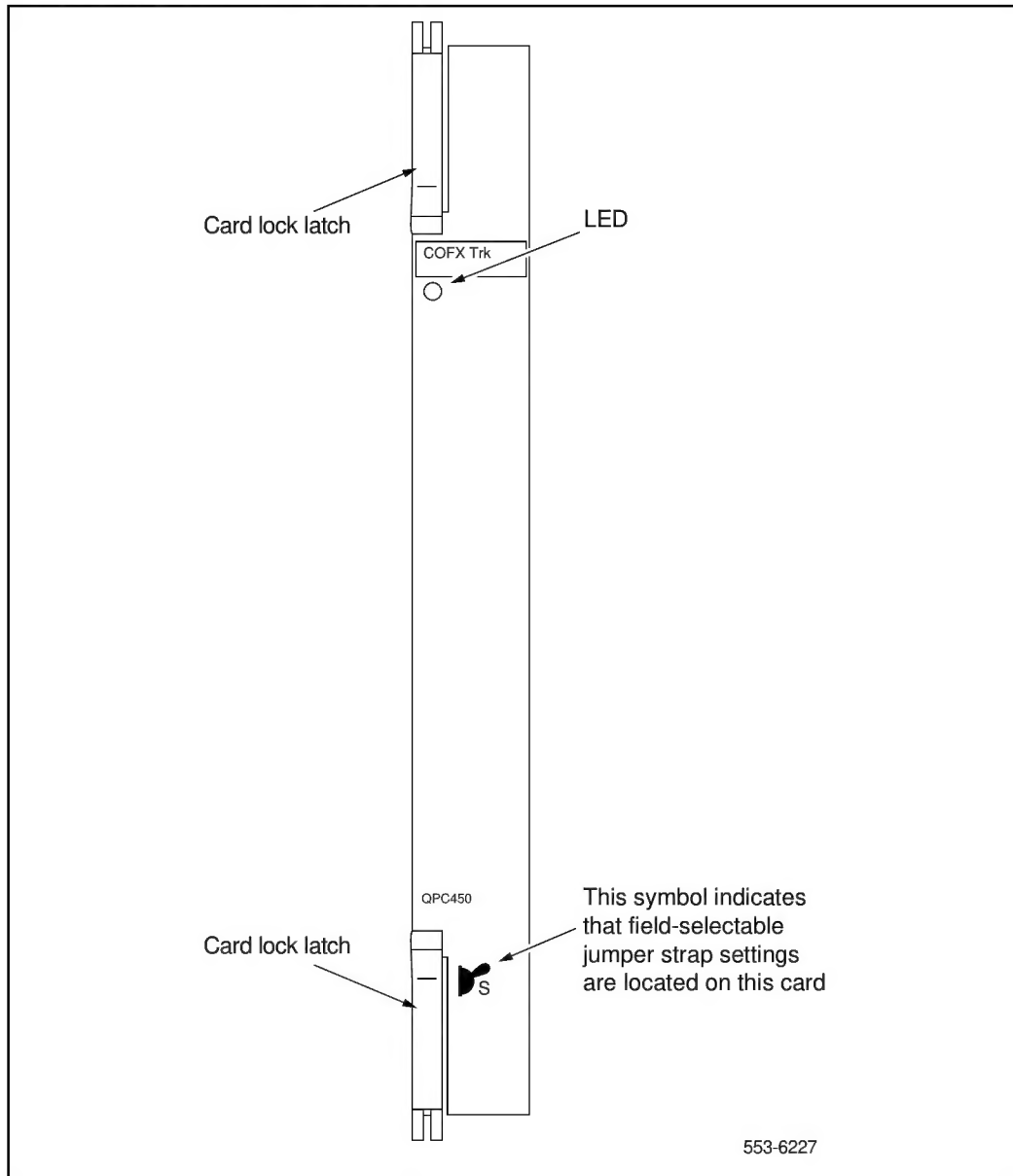
Physical description

The CO/FX/WATS trunk card mounts in any PE slot. The four trunk circuits and common multiplexing circuitry are mounted on a 31.74 cm by 25.4 cm (12.5 in. by 10 in.) printed circuit board.

The CO/FX/WATS trunk card connects to the backplane through an 80-pin connector shroud. The backplane is then cabled to the input/output (I/O) panel, which is cabled to the main distribution frame (MDF) by 25-pin cables. Trunk lines connect to the card at the MDF. See *Meridian 1 system installation procedures* (553-3001-210) for termination and cross connect information.

The faceplate of the card is equipped with a red light emitting diode (LED) (see [Figure 102](#)). This LED is only lit when there is a problem with the board. If the LED operates in any other manner, such as continually flashing or remaining weakly lit, the card should be replaced.

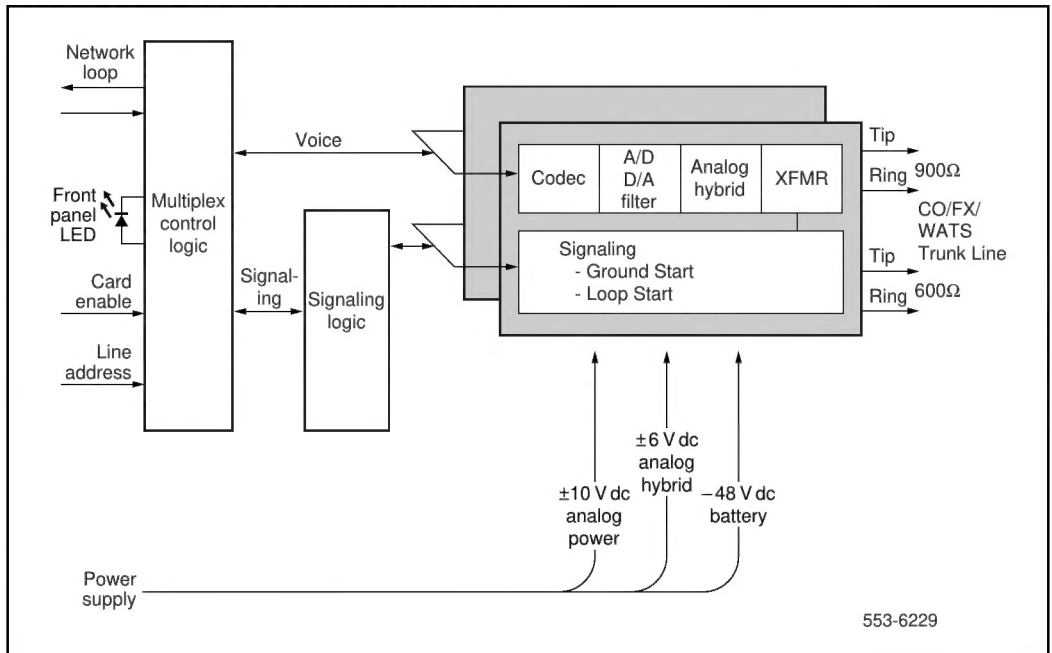
Figure 102
CO/FX/WATS trunk card—faceplate



Functional description

Figure 103 shows a block diagram of the major functions contained on the CO/FX/WATS trunk card. Each of these functions is described on the following pages.

Figure 103
CO/FX/WATS trunk card—block diagram



Card interfaces

The CO/FX/WATS trunk card passes both voice and signaling data over the network loop. Network loops are discussed in detail in “Peripheral equipment” on page 22.

Trunk interface units

The CO/FX/WATS trunk card contains four identical and independently configurable trunk interface units (also referred to as circuits). Each unit provides impedance matching and a balance network in a signal transformer/analog hybrid circuit. Also provided are relays for placing outgoing call signaling onto the trunk. Signal detection circuits monitor incoming call signaling.

Four codecs are provided for performing A/D and D/A conversion of trunk analog voiceband signals to digital PCM signals. Each codec supports one trunk interface unit. The following features are common to all units on the card:

- 2- to 4-wire conversion of the transmission path
- analog-to-digital and digital-to-analog conversion of transmission signals
- ground start and loop start signaling modes (selected by option switches on the card)
- –48 or –24 V CO battery options accommodated automatically
- ground detection on the tip lead
- loop current supervision
- ringing detection (also on positive battery)
- polarity detection of the loop

Two control circuits (each controlling two trunk units) each provide the interface with connections to the peripheral signaling bus, retime the digital signals, decode the unit addresses to enable the codecs at the correct timeslot, and control the signaling relays. Sensing circuitry is provided to detect second-pair signaling, third-wire battery signaling, and third-wire ground signaling.

Audio signals received from the tip and ring of the circuit card are fed to the analog-to-digital filter through the hybrid transformer. The analog-to-digital filter and external components form a 26 dB, 60 Hz rejection filter.

The filter limits the frequency range to a nominal 200 to 3400 Hz bandwidth and amplifies the signal for application to the codec. The codec encodes the analog signal, producing a digital signal, which is applied to the common multiplexing circuit.

Digital signals from the multiplexing circuit and the data output bus are fed to the codec and decoded to produce an analog output. The analog output of the codec is fed to the filter. This amplifies and filters the resulting signal, which is fed to the tip and ring of the circuit through the hybrid transformer.

Each unit on the card connects to a trunk facility through tip and ring leads that carry voice, ringing, tone signaling, and battery. All CO/FX/WATS trunks have an optional 600 or 900 ohm balanced terminating impedance. One pair of leads for each option is run to the cross connect terminal, where the cross connection is made to the desired tip/ring pair.

Each unit has option switches for selecting loop or ground start mode and 600 or 900 ohm terminating impedance.

Card functions

Multiplex control

The multiplex control logic is common to all four channels. This logic interfaces the individual trunk circuits to the peripheral bus signaling channel. Circuits are provided in the multiplex control logic to retime the digital signals received from the peripheral bus. Other circuits decode the address information contained on the peripheral bus to enable the individual trunk circuits during their selected timeslots. Logic is also provided to enable or disable the front panel LED to indicate the service state of the card. The multiplex control logic is discussed in detail in “Peripheral equipment” on page 22.

Operation

Optional applications, features, and signaling arrangements for each trunk are assigned through the Trunk Route Administration (LD 16) and the Trunk Administration (LD 14) overlay programs.

Release control

Release control of a call over a trunk is specified in the Route Data Block. Disconnect supervision is specified independently for each trunk group.

Only incoming trunks in idle ground start configuration can provide disconnect supervision. For a list of prompts, responses, and default conditions, see LD 14 and LD 16.

Reverse battery application of metering

When the CO returns reverse battery as a pulse signal, only one pulse is received for each CO call. This pulse is passed directly to the software meter for storage. The call charge may be provided on CDR if equipped. If the call is flagged by the attendant as metered, on termination of the call the total charge or pulse count for the call is shown on the console display.

Periodic metering pulse application of metering

With this method, more than one pulse may be returned for each call. The CO sends signals over the tip and ring lead of the trunk. The number of signals sent depends on the duration and, in some cases, the distance of a call. In most cases the signal sent is one of the following types:

- 50 Hz signals
- 16 kHz signals
- 12 kHz signals

Signals from the CO are converted to pulses by a receiver unit. The receiver unit passes the pulses in an 8-bit counter. Once the counter has stored 256 pulses, it generates a CPU interrupt signal, which increments the temporary meter assigned to the call by 256, and the counter resets to 0. When a call is terminated, or when call modification occurs (for example, a call is transferred), the counter increments the temporary meter by the number of pulses stored at that moment, and the counter resets to 0.

Pulse detector

The pulse detector (MR/PPM) circuitry on the trunk is provided with switches to accommodate the various signaling arrangements as follows:

- third wire, battery signaling
- third wire, ground signaling
- second pair

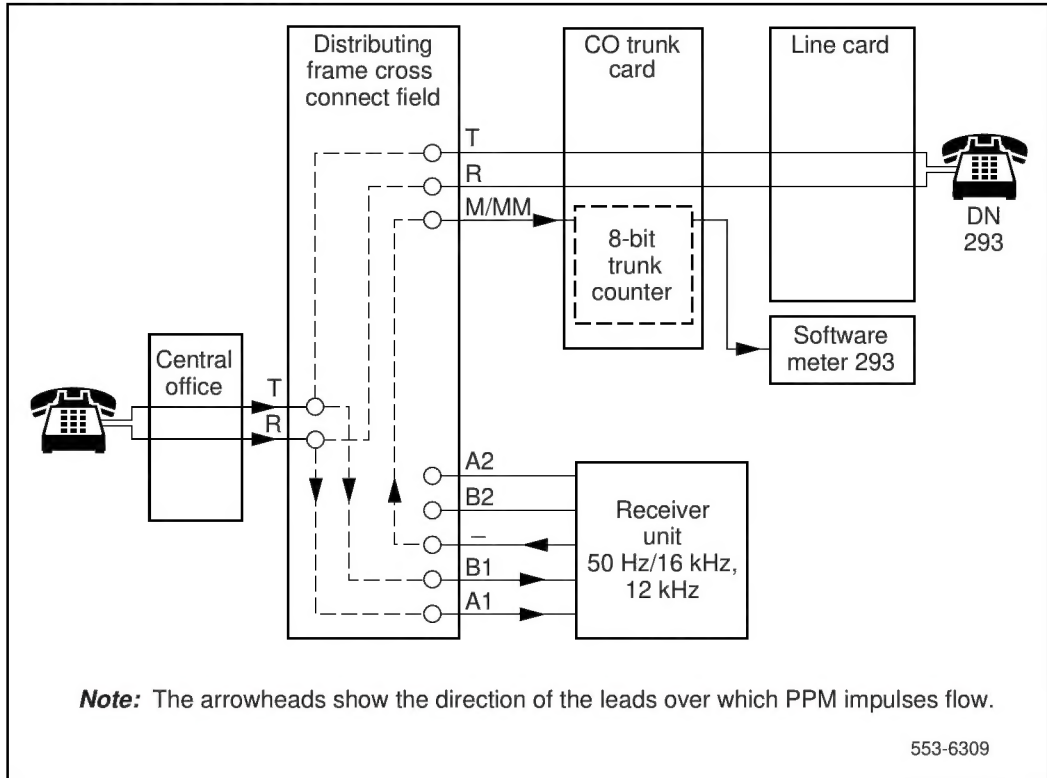
The trunk cards generate two interrupt signals for each pulse received from the CO.

PPM interface circuit application

CO trunks used for PPM must connect to an interface circuit. The receiver unit converts 50 Hz, 12 kHz, or 16 kHz signals from the CO into logic signals for storage in the trunk counter.

Connection to interface circuits is required for storage when the CO returns signals other than reverse battery. The interface circuits (receiver units) extract the signals (50 Hz/16 kHz/12 kHz) from the tip and ring leads of the trunk and send a logic signal to the trunk on the third wire. One receiver unit is required for each trunk. [Figure 104](#) shows how this circuit interfaces with the Meridian 1.

Figure 104
Metering pulse operation



Line operation

Idle state

During idle state:

- tip is open
- CO battery (–48 or –24 V) is applied to the ring
- during each timeslot 0, the CE scans each trunk to detect any change on the data input bus

Ground start trunk

The operational sequences and signaling patterns for a ground start trunk operation are provided in [Figures 105](#) to [108](#).

Loop start trunks

The operational sequences and signaling patterns for a loop start trunk operation are provided in [Figures 109](#) and [110](#).

Figure 105
Ground start trunk incoming call connection sequence

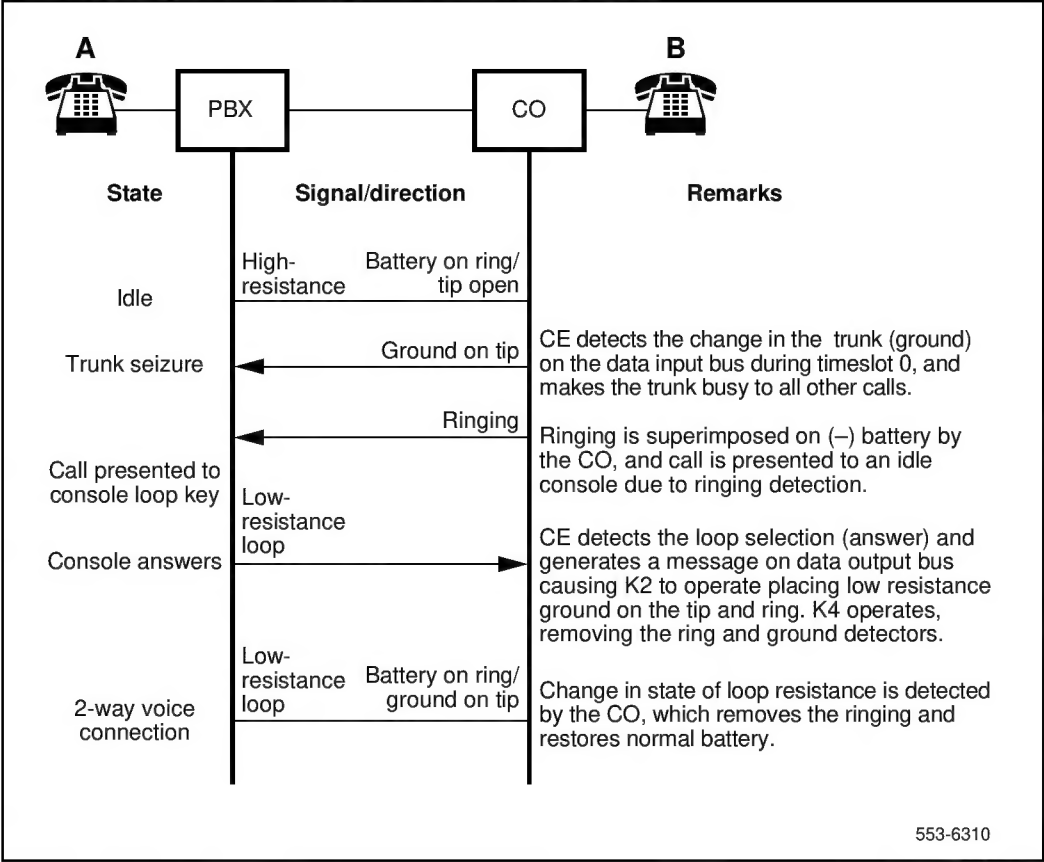


Figure 106
Ground start trunk outgoing call connection sequence

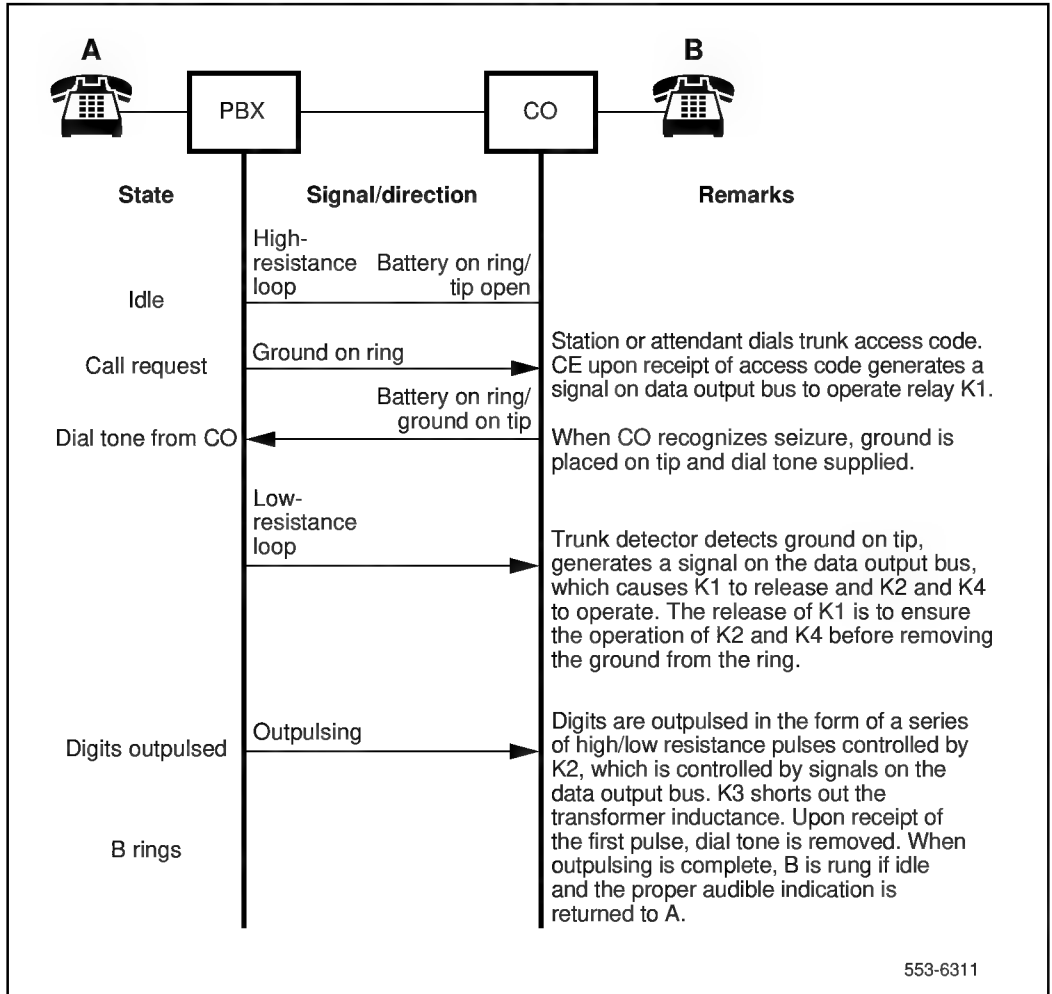


Figure 107
Near end (Meridian 1) disconnects first

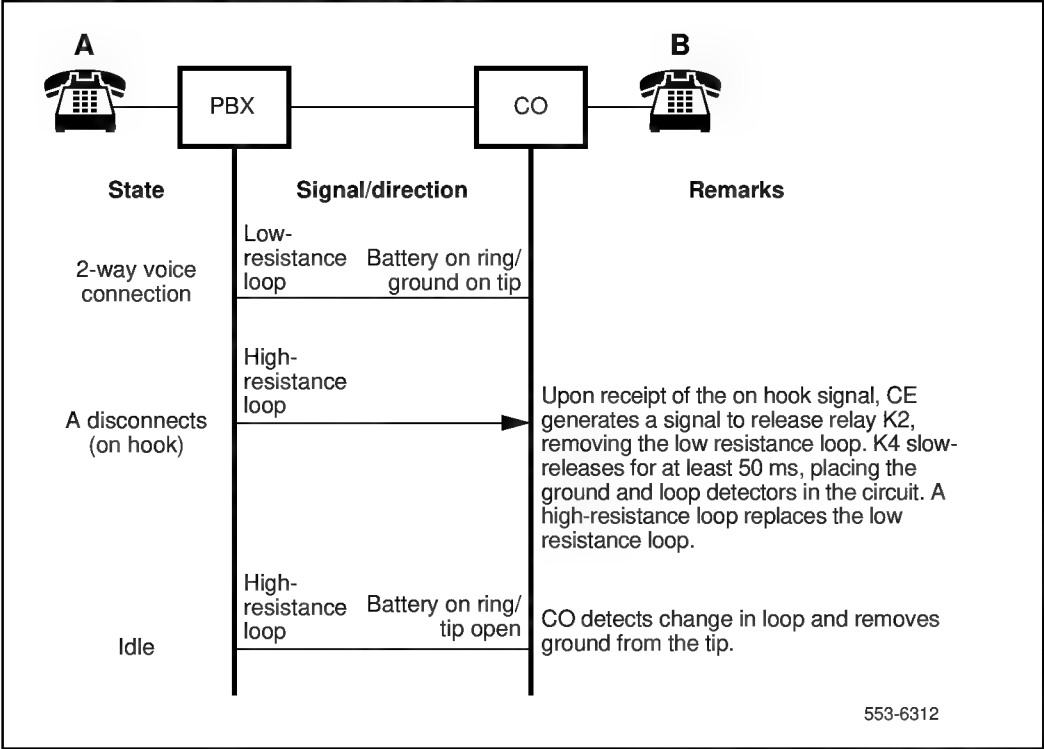


Figure 108
Far end (CO) disconnects first

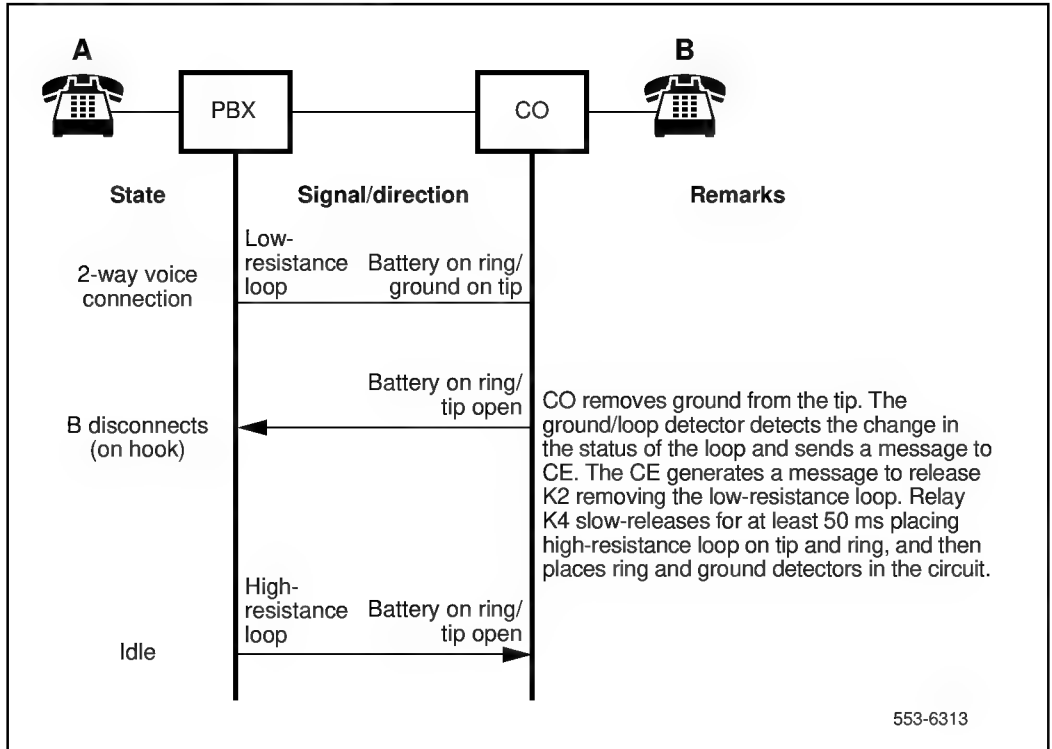


Figure 109
Loop start trunk incoming call connection sequence

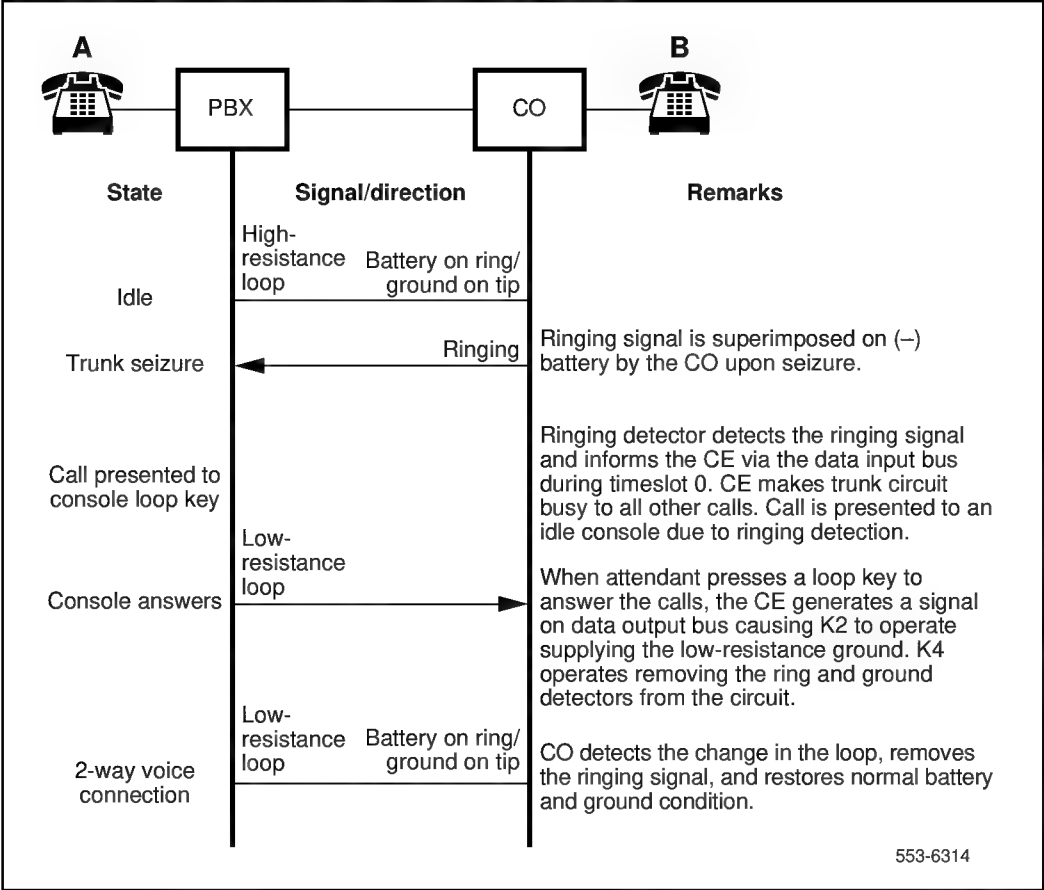
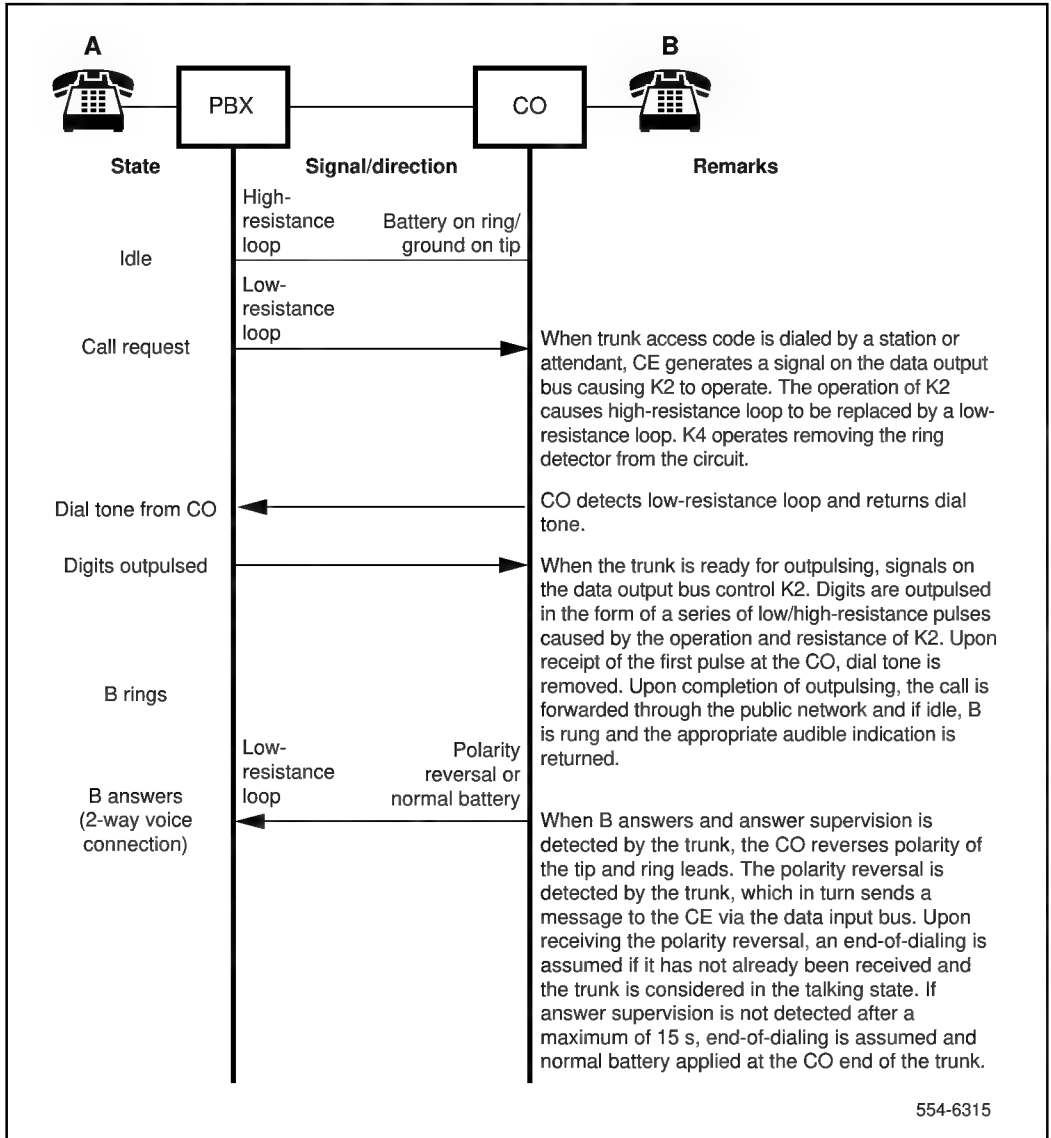


Figure 110
Loop start trunk outgoing call connection sequence



Electrical specifications

This section gives the electrical specifications for the CO/FX/WATS trunk card.

Trunk interface electrical characteristics

[Table 68](#) gives the electrical characteristics for the trunk interface units on the CO/FX/WATS trunk card.

Table 68
Trunk characteristics

Characteristic	Specification
Nominal impedance	600 to 900 Ω , selected with option switches and at cross connect terminal
Signaling range	1700 Ω
Signaling type	Ground or loop start
Far-end battery	-42 to -52.5 V
Near-end battery	-42.75 to -52.5 V
Minimum Loop Current	20 mA
Ground potential difference	± 10 V
Low DC loop resistance during outpulsing	300 Ω
High DC loop resistance	Ground start ≥ 20 k Ω , Loop start ≥ 150 k Ω
Line leakage	30 k Ω (tip to ring, tip to ground, ring to ground)
Effective loss	1.0 dB line-to-trunk 1.0 dB trunk-to-trunk

Overload level

Signal levels exceeding +3 dBm applied to the tip and ring cause distortion in speech transmission (line-to-trunk connection).

Power requirements

[Table 69](#) lists the power requirements for CO/FX/WATS trunk the card.

Table 69
Power requirements

Voltage	Tolerance
+6 V dc	±1%
−6 V dc	±1%
+10 V dc	±5%
−10 V dc	±5%
−48 V dc	±5%
−52 V dc	±5%
+2.5 V dc	±5%

Foreign and surge voltage protections

When telephone lines connected to the trunk circuit are exposed to foreign voltages by direct contact or induction (e.g., power line crosses or lightning), protection devices must be installed on the customer's premises. These devices must be capable of providing a path to ground from tip and ring for foreign voltages that exceed 600 V peak.

Environmental specifications

[Table 70](#) lists the environmental specs. for the CO/FX/WATS trunk card.

Table 70
Environmental specifications

Parameter	Specifications
Operating temperature	0° to +50° C (+32 to +122° F), ambient
Operating humidity	5 to 95% RH (noncondensing)
Storage temperature	−40° to +70° C (−40° to +158° F)

Connector pin assignments

The CO/FX/WATS trunk card brings the analog trunks to the PE backplane through an 80-pin connector shroud. The backplane is cabled to the input/output (I/O) panel on the rear of the module, which is then connected to the main distribution frame (MDF) by 25-pair cables.

Telephone trunks connect to the CO/FX/WATS trunk card at the MDF using a wiring plan similar to that used for line cards. A typical connection example is shown in [Figure 111](#), and a list of the connections to the CO/FX/WATS trunk card is shown in [Table 71](#). See *Meridian 1 system installation procedures* (553-3001-210) for complete I/O panel connector information and wire assignments for each tip/ring pair.

Figure 111
CO/FX/WATS trunk card—typical cross connection example

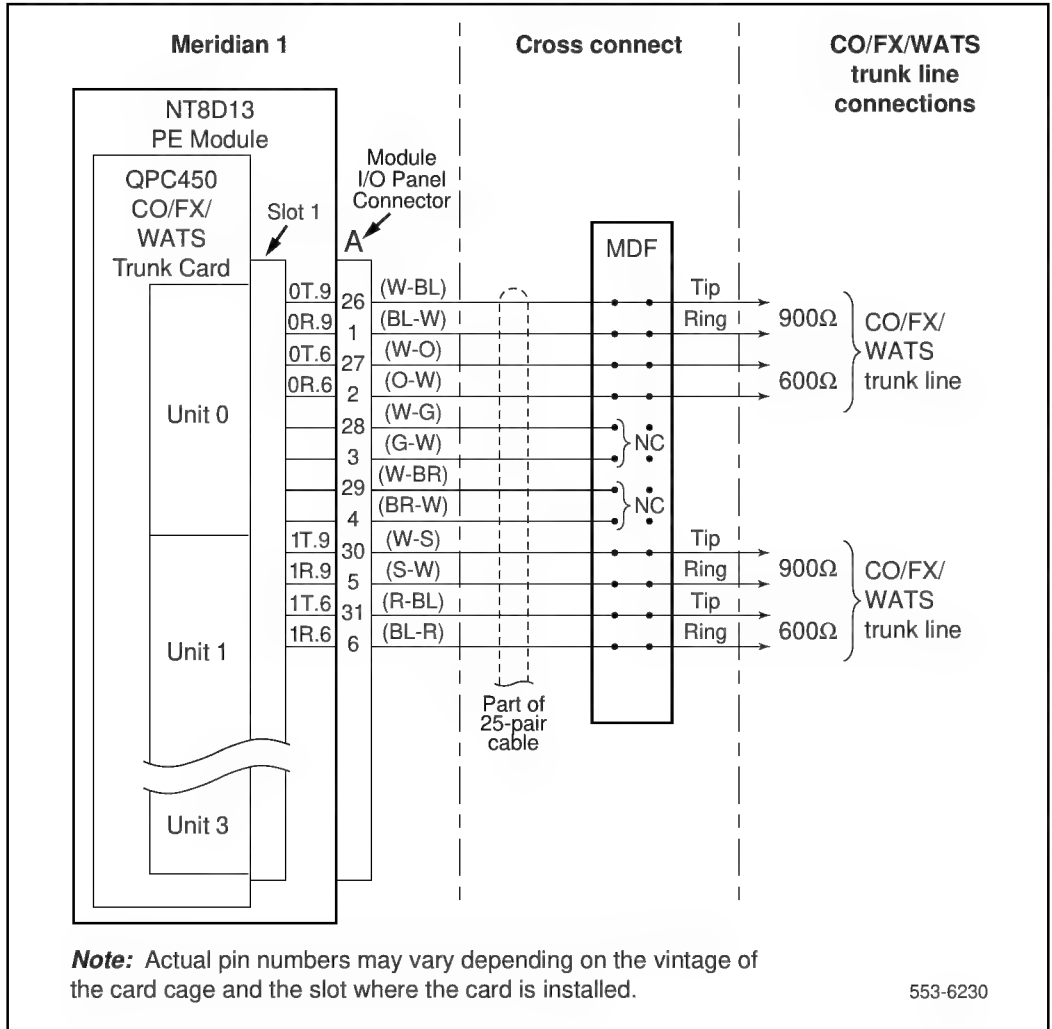


Table 71
CO/FX/WATS trunk card—backplane pinouts

Connector Pin	Signal	Unit
36A	Tip, 900Ω	0
37A	Ring, 900Ω	
38A	Tip, 600Ω	
39A	Ring, 600Ω	
29A	Tip, 900Ω	1
30A	Ring, 900Ω	
31A	Tip, 600Ω	
32A	Ring, 600Ω	
2A	Tip, 900Ω	2
3A	Ring, 900Ω	
4A	Tip, 600Ω	
5A	Ring, 600Ω	
9A	Tip, 900Ω	3
10A	Ring, 900Ω	
11A	Tip, 600Ω	
12A	Ring, 600Ω	

Configuration

The trunk type for each unit on the card as well as its terminating impedance and balance network configuration is selected by software service change entries at the system terminal and by switch and jumper settings on the card. The locations of these switches are shown in [Figure 112](#).

Switch and jumper settings

[Tables 72](#) through [76](#) list the switch and jumper settings for the CO/FX/WATS trunk cards. There is one table for each revision (vintage) of the card.

Figure 112
CO/FX/WATS trunk card—switch and jumper settings

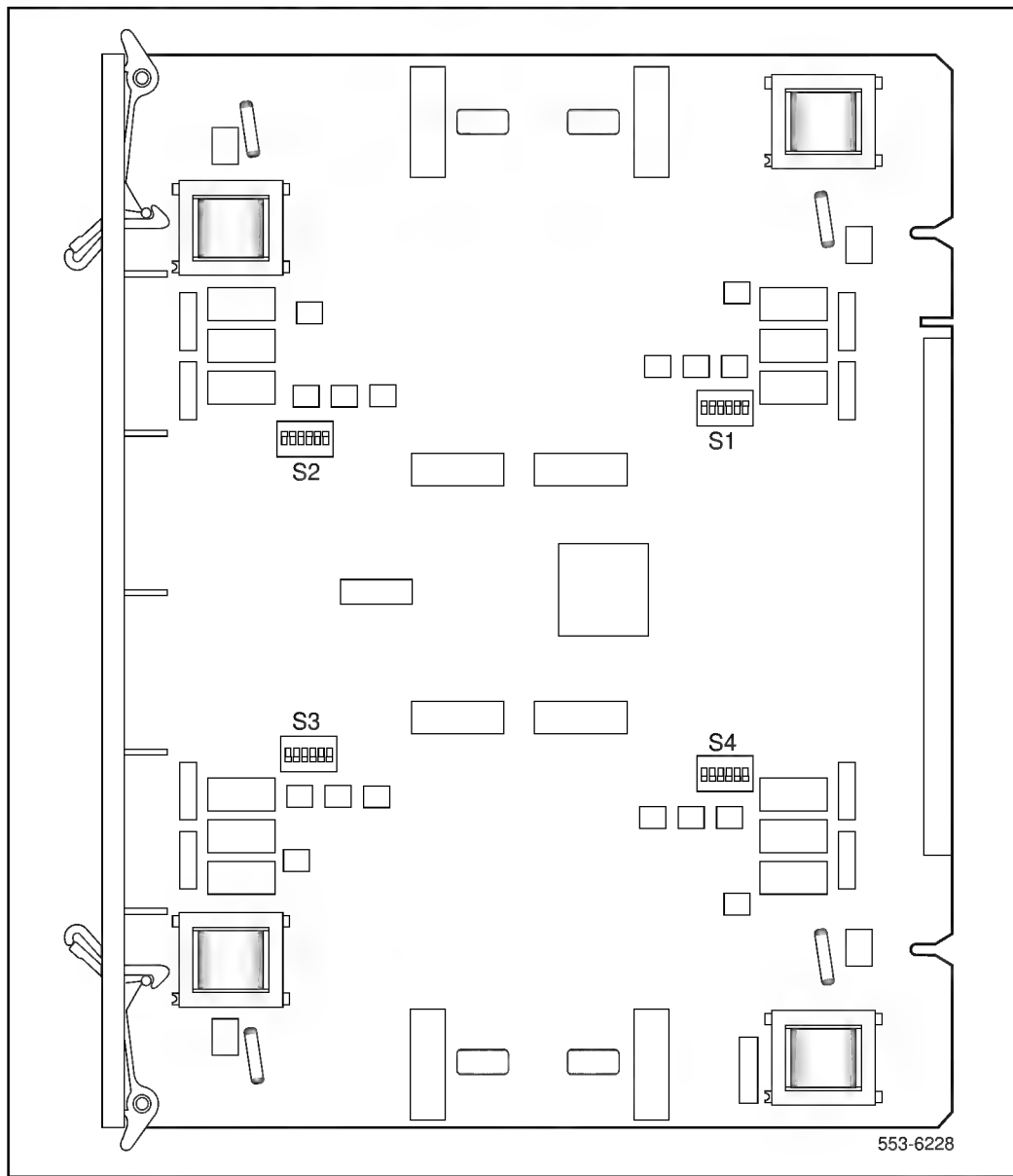


Table 72**QPC450A&B vintage CO/FX/WATS trunk card—switch and jumper settings**

Switch Settings										
Switch Position:	Switch S1 (Location A23)									
	1	2	3	4	5	6	7	8		
	On	Off	On	Off	On	Off	On	Off		
Switch Position:	Unit 0: Switch S2 (Location E29) Unit 1: Switch S3 (Location E9) Unit 2: Switch S4 (Location E28) Unit 3: Switch S5 (Location E10)									
	1	2	3	4	5	6	7	8	9	10
Trunk type:										
Loop Start	Off	On	Off	Off	On	Off			Off	Off
Ground Start	Off	On	On	On	On	Off			Off	Off
Metering:										
Second Pair (M,MM) or								Off	Off	
Third wire, battery on M or								Off	On	
Third wire, ground on M								On	Off	
Jumper Settings										
Jumper:	Unit 0 jumper: Location E27 Unit 1 jumper: Location E11 Unit 2 jumper: Location D29 Unit 3 jumper: Location D9									
	Unit 0 Jumper	Unit 1 Jumper	Unit 2 Jumper	Unit 3 Jumper						
600 Ω resistive impedance	Pin 1 to 2	Pin 1 to 2	Pin 1 to 2	Pin 1 to 2						
three-component complex impedance	Pin 2 to 3	Pin 2 to 3	Pin 2 to 3	Pin 2 to 3						

Table 73
QPC450C CO/FX/WATS trunk card—switch settings

Switch Settings								
Switch Position:	Unit 0: Switch S2 (Location E29) Unit 1: Switch S3 (Location E9) Unit 2: Switch S4 (Location E28) Unit 3: Switch S5 (Location E10)							
	1	2	3	4	5	6	7	8
Trunk type:								
Loop Start	Off	On	Off	Off	On			Off
Ground Start	Off	On	On	On	On			Off
Metering:								
Second Pair (M,MM) or						Off	Off	
Third wire, battery on M or						Off	On	
Third wire, ground on M						On	Off	

Table 74
QPC450C1 & D CO/FX/WATS trunk card—switch settings

Switch Settings								
Switch Position:	Unit 0: Switch S4 (Location F28) Unit 1: Switch S3 (Location F10) Unit 2: Switch S1 (Location C27) Unit 3: Switch S2 (Location B10)							
	1	2	3	4	5	6	7	8
Trunk type:								
Loop Start	Off	On	Off			Off	Off	On
Ground Start	Off	On	On			On	Off	On
Metering:								
Second Pair (M,MM) or				Off	Off			
Third wire, battery on M or				Off	On			
Third wire, ground on M				On	Off			

Table 75
QPC450 E&F trunk cards—switch settings

Switch Settings				
Switch Position:	Unit 0: Switch S4 (Location F25) Unit 1: Switch S3 (Location F11) Unit 2: Switch S1 (Location B25) Unit 3: Switch S2 (Location B13)			
	1	2	3	4
Trunk type:				
Loop Start	Off	Off		
Ground Start	On	On		
Metering:				
Second Pair (M,MM) or			Off	Off
Third wire, battery on M or			Off	On
Third wire, ground on M			On	On

Table 76
QPC450G CO/FX/WATS trunk card—switch settings

Switch Settings						
Switch Position:	Unit 0: Switch S4 (Location F25) Unit 1: Switch S3 (Location F11) Unit 2: Switch S1 (Location B25) Unit 3: Switch S2 (Location B13)					
	1	2	3	4	5	6
Trunk type:						
Loop Start	Off	Off				
Ground Start	On	On				
Loop Length:						
— Short loops (600 Ω compromise impedance network)					On	Off
— Long loop (EIA-recommended impedance network)					Off	On

Service change entries

The trunk type, features, signaling arrangement, and insertion loss for each trunk are selected by making service change entries in the Trunk Administration program (LD 14). Refer to the Meridian 1 *X11 input/output guide* for LD 14 service change instructions.

Pad switching

The transmission properties of each trunk are characterized by the class of service assigned in LD 14. Transmission properties can be via net loss (VNL) or non via net loss (non-VNL).

The VNL class of service is assigned at the prompt CLS with the response VNL. The non-VNL class of service is assigned at prompt CLS by selecting either the TRC (transmission compensated) or NTC (non-transmission compensated) response.

Non-VNL trunks are assigned a TRC or NTC class of service to ensure stability and minimize echo when connecting to long-haul trunks, such as tie trunks. The class of service determines the operation of the switchable pads contained in each unit. They are assigned as follows:

- TRC for a 2-wire non-VNL trunk facility with a loss of greater than 2 dB, or for which impedance compensation is provided, or for a 4-wire non-VNL facility
- NTC for a 2-wire, non-VNL trunk facility with a loss of less than 2 dB, or when impedance compensation is not provided

Pad switching provides proper insertion loss and echo protection, when required. The control of pad switching for the various through connections and the actual loss introduced is given in [Figure 113](#).

Figure 113
Pad switching algorithm

Through connection				Terminal balance						Through balance					
From To Legend <table><tr><td>IN</td><td>Pad switched IN</td></tr><tr><td>OUT</td><td>Pad switched OUT</td></tr><tr><td>NA</td><td>Not applicable</td></tr></table>				IN	Pad switched IN	OUT	Pad switched OUT	NA	Not applicable	Station lines Attendant lines	Non-VNL				VNL
				IN	Pad switched IN										
				OUT	Pad switched OUT										
				NA	Not applicable										
Non-transmission compensated (2 wire facility loss <2 dB or not impedance compensated)		Transmission compensated (2-wire facility loss >2 dB or impedance compensated or 4-wire facility)		Tie	CO/FX/WATS & CCSA	QPC71 or equivalent									
Station lines Attendant lines				NA	OUT	OUT	OUT	OUT	IN						
				(5)	(1)	(1)	(1)	(1)	(1)	(3)					
				NA	NA	NA	NA	NA	NA	NA					
Terminal balance	Non-VNL	Non-transmission compensated (2 wire facility loss <2 dB or not impedance compensated)	CO/FX/WATS & CCSA	NA	OUT	IN	OUT	IN	IN	* IN					
			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(3)					
			Tie	OUT	IN	OUT	IN	OUT	IN	IN					
			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)					
		Transmission compensated (2 wire facility loss <2 dB or impedance compensated or 4-wire facility)	CO/FX/WATS & CCSA	NA	OUT	IN	OUT	IN	OUT	IN	OUT				
			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)				
			Tie	OUT	IN	OUT	IN	OUT	IN	IN	IN				
			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)				
Through balance	VNL	4-wire { Tie CCSA	QPC71 or equivalent	* NA	IN	IN	IN	IN	IN						
			(3)	(1)	(3)	(1)	(1)	(1)	(1)						

Note 1: Actual loss (dB) for each connection is given in parentheses.

Note 2: All trunks (except QPC71) have an effective gain of 1.5 dB and contain 4 dB switchable pads.

Note 3: The Meridian 1 controls the overall connection-to-connection gain.

Note 4: Entries marked “*” have 1 dB instead of 3 dB.

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553-6316

Meridian 1

Trunk cards

Description

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Northern Telecom reserves the right to make changes in design or components as progress in engineering and manufacturing may warrant. This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC rules, and the radio interference regulations of Industry Canada. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

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